

A Review of Deep Learning in Medical Imaging: Imaging Traits, Technology Trends, Case Studies With Progress Highlights, and Future Promises

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Abstract

Since its renaissance, deep learning (DL) has been widely used in various medical imaging tasks and has achieved remarkable success in many medical imaging applications, thereby propelling us into the so-called artificial intelligence (AI) era. It is known that the success of AI is mostly attributed to the availability of big data with annotations for a single task and the advances in high-performance computing. However, medical imaging presents unique challenges that confront DL approaches. In this survey article, we first present traits of medical imaging, highlight both clinical needs and technical challenges in medical imaging, and describe how emerging trends in DL are addressing these issues. We cover the topics of network architecture, sparse and noisy labels, federating learning, interpretability, uncertainty quantification, and so on. Then, we present several case studies that are commonly found in clinical practice, including digital pathology and chest, brain, cardiovascular, and abdominal imaging. Rather than presenting an exhaustive literature survey, we instead describe some prominent research highlights related to these case study applications. We conclude with a discussion and presentation of promising future directions.